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1. Your reference — P/61815.GBP

2. Patent application number *(The Patent Office will fill in this part)* — 0013323.1 — 02 JUN 2000

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

MARCONI COMMUNICATIONS LIMITED
P O BOX 53, NEW CENTURY PARK
COVENTRY
CV3 IHJ

7519200001

Patents ADP number *(if you know it)*
If the applicant is a corporate body, give the country/state of its incorporation — ENGLAND

4. Title of the invention — MESH NETWORKS

5. Name of your agent *(if you have one)*

"Address for service" in the United Kingdom to which all correspondence should be sent

(including the postcode)

Patents ADP number *(if you know it)*

H A BRANFIELD

MARCONI INTELLECTUAL PROPERTY
WATERHOUSE LANE
CHELMSFORD
ESSEX CM1 2QX

7910894001

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Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*
GB	9913990.9	17.06.99

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

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Claim(s)	2
Abstract	1
Drawing(s)	6 + 6

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Statement of inventorship and right to grant of a patent (Patents Form 7/77)	1
Request for preliminary examination and search (Patents Form 9/77)	1
Request for substantive examination (Patents Form 10/77)	1
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	Signature	Date
	H A BRANFIELD	31.05.2000
12. Name and daytime telephone number of person to contact in the United Kingdom	H A BRANFIELD	01245 275132

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MESH NETWORKS

In networks, such as telecommunication networks, fully meshed networks are often used to interconnect the nodes together and in particular to interconnect trunk exchanges. Although fully meshed networks can be of considerable use, they do have the characteristic that the more nodes there are in a fully meshed network, then the narrower the routes between nodes have to be once the switches are port limited. Doubling the nodes in a fully meshed network can halve the size of each route across the mesh. However, reducing the route size can increase the chance of blocking as well as reducing the Erlang efficiency.

In some telecommunication networks each fully meshed trunk exchange is also connected to several local exchanges, so that the longer distance trunk calls tend to traverse four exchanges namely a local, a trunk, a second trunk and a final local.

In such a network the local exchanges only need to know if a call originating on its own exchange cannot be terminated on its own exchange, in which case the call is forwarded to a trunk exchange.

For reasons of redundancy a local exchange is normally connected to more than one trunk exchange, in which case a call which cannot be terminated on its own exchange can probably be forwarded to any of the connected trunk exchanges.

However if the local exchanges are connected to more trunk exchanges than are needed for redundancy reasons, then the local exchange could be asked to perform part of the overall trunk routing algorithm. Consequently the intended final destination of the call can be used to decide to which trunk exchange the call should be sent to by the local exchange.

Provided the local exchange is able to route to more than one trunk exchange depending on the destination of the call, then it is possible to use a pair of trunk exchanges to perform the function of one existing trunk exchange, with approximately twice the capacity and throughput. This is assuming that the two exchanges each have the same or similar capacity to the existing trunk exchange. The existing trunk exchange can be one of the pair of trunk exchanges. The pair of trunk exchanges can be known as Siamese trunk exchanges.

According to the present invention there is provided a telecommunications network comprising a plurality of mesh nodes, each mesh node including one or more switches, at least one of the mesh nodes including a plurality of switches, each mesh node having a connection to each other mesh node by means of a connection between a switch at the one mesh node and a switch at the other mesh node and each mesh node having associated therewith a respective plurality of local nodes, each switch of each mesh node being connected to all of the respective associated plurality of local nodes and including a network routing algorithm to control the routing in the network

There is further provided a method of upgrading a telecommunications network, said telecommunications network comprising a plurality of mesh nodes, wherein each mesh node includes at least one switch, each mesh node having a direct connection to each other mesh

node by means of a connection between a switch at the one mesh node and a switch at the other mesh node and the switch or switches of each mesh node being each connected to all of a respective plurality of multiple local nodes, the method comprising the steps of :-

(a) adding a further switch to at least one of the mesh nodes;

(b) connecting all of the respective plurality of local nodes to the further switch;

(c) providing a network routing algorithm to control the routing in the network; and

(d) dividing the connections from the at least one mesh node to the switches of the other mesh nodes between the switch or switches and the further switch of the at least one mesh node.

The present invention will now be described by way of example, with reference to the accompanying drawings in which:

Figure 1 shows an example of a network having a number of fully meshed mesh nodes;

Figure 2 shows an example of a fully meshed mesh node of the network shown in Figure 1 connected to multiple local nodes;

Figure 3 shows an example of a fully meshed mesh node of the network shown in Figure 1 with a single switch;

Figure 4 shows an example of a fully meshed mesh node of the network shown in Figure 1 with two unconnected switches;

Figure 5 shows an example of a fully meshed mesh node of the network shown in Figure 1 with two connected (Siamese) switches; and

Figure 6 shows an example of a network as shown in Figure 1 including a number of fully meshed mesh nodes where each node has two switches.

Figure 1 shows an example of a network having fully meshed mesh nodes, such as trunk exchanges, where each mesh node is directly connected to every other mesh node. In practice these links are often carried by transmission systems.

In Figure 2 some of the mesh nodes (trunk exchanges) of Figure 1 are shown connected to multiple local nodes, such as local exchanges. In practice these connections are often carried by transmission systems. The connection of multiple local exchanges to trunk exchanges is a recognised telecommunication network configuration.

Figure 3 shows a mesh node of Figure 2 containing a single switch. Such a switch could be a trunk exchange equipment. This switch is connected to all the other mesh Nodes as well as all the illustrated multiple Local Nodes. The illustrated Local Nodes may also be connected to switches at other mesh nodes.

Figure 4 shows the mesh node of Figure 3, to which has been added a further switch. Any added switches could be trunk exchanges. The direct links from the other mesh nodes are taken to one or the other, but not both, of the switches. The pair of switches are both connected to all the multiple local nodes associated with that mesh node. The local nodes have to be able to route calls or messages to the appropriate one of the pair of switches.

Figure 5 shows the mesh node containing two switches as in Figure 4, but with a connection (Siamese link) between them. If the connection between an local node and the switch that is normally used to route a call or message is congested, then if the connection to the other one

of the pair of switches is not congested then this connection and the Siamese link can be used in series, to avoid the congestion. The Siamese link is not essential, but can be a useful feature for practical networks.

Figure 6 shows an example of a network where all the Mesh Nodes each have two switches, each pair of switches within a mesh node being joined by a Siamese link. The overall result is that each switch is connected to approximately one half of the other mesh nodes and approximately one quarter of the other switches. For larger examples the approximations can be more precise, but there is no basic need to equally divide the routes between the mesh nodes and the switches. Some routes may naturally carry more traffic and some pairs of switches may not have identical characteristics to each other.

The network will require a network routing algorithm to control the routing of messages, of whatever form through the network.

CLAIMS

1. A telecommunications network comprising a plurality of mesh nodes, each mesh node including one or more switches, at least one of the mesh nodes including a plurality of switches, each mesh node having a connection to each other mesh node by means of a connection between a switch at the one mesh node and a switch at the other mesh node and each mesh node having associated therewith a respective plurality of local nodes, each switch of each mesh node being connected to all of the respective associated plurality of local nodes and the network including a network routing algorithm to control the routing in the network.

2 A telecommunications network as claimed in Claim 1, wherein one or more local nodes are connected to more than one mesh node.

3. A telecommunications network as claimed in Claim 1 or 2, wherein the plurality of switches of a mesh node are connected.

4. A telecommunications network substantially as hereinbefore described, with reference to and as illustrate in Figures 4, 5 and 6 of the accompanying drawings.

5. A method of upgrading a telecommunications network, said telecommunications network comprising a plurality of mesh nodes, wherein each mesh node includes at least one switch, each mesh node having a direct connection to each other mesh node by means of a connection between a switch at the one mesh node and a switch at the other mesh node and the switch or switches of each mesh node being each connected to all of a respective plurality of multiple local nodes, the method comprising the steps of :-
(a) adding a further switch to at least one of the mesh nodes;
(b) connecting all of the respective plurality of local nodes to the further switch or switches;
(c) providing a network routing algorithm to control the routing in the network; and
(d) dividing the connections from the at least one mesh node to the switches of the other mesh nodes between the switch or switches and the further switch of the at least one mesh node.

6. A method of upgrading a telecommunications network as claimed in Claim 5, further including the step of making a connection between the switches of the at least one mesh node.

7. A method of upgrading a telecommunications network as claimed in Claim 4 and substantially as hereinbefore described and as illustrated in Figures 3, 4, 5 and 6 of the accompanying drawings.

ABSTRACT

A telecommunications network having a plurality of mesh nodes, where each mesh node includes one or more switches and at least one of the mesh nodes includes a plurality of switches, each mesh node having a connection to each other mesh node and each mesh node having associated with it a respective plurality of local nodes, each switch of each mesh node being connected to all of the respective associated plurality of local nodes. The network may be upgraded by adding a further switch to a mesh node and connecting all the respective local nodes to that switch and sharing the connections between the switches of the mesh node. A suitable network routing algorithm controls the routing in the network.

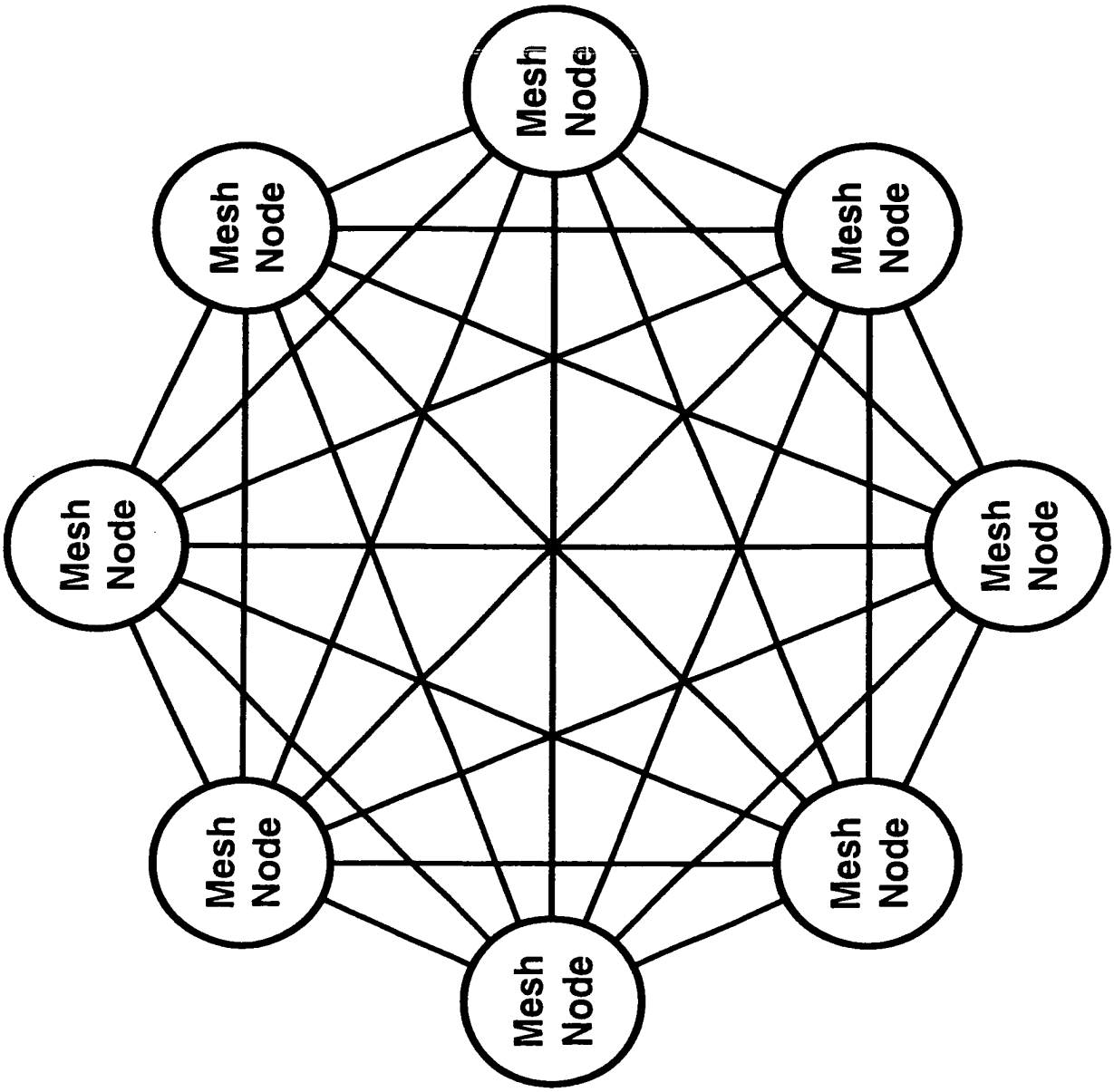

Mesh Node
Mesh Node
Mesh Node
Mesh Node
Mesh Node
Mesh Node
Mesh Node

Fig.1.

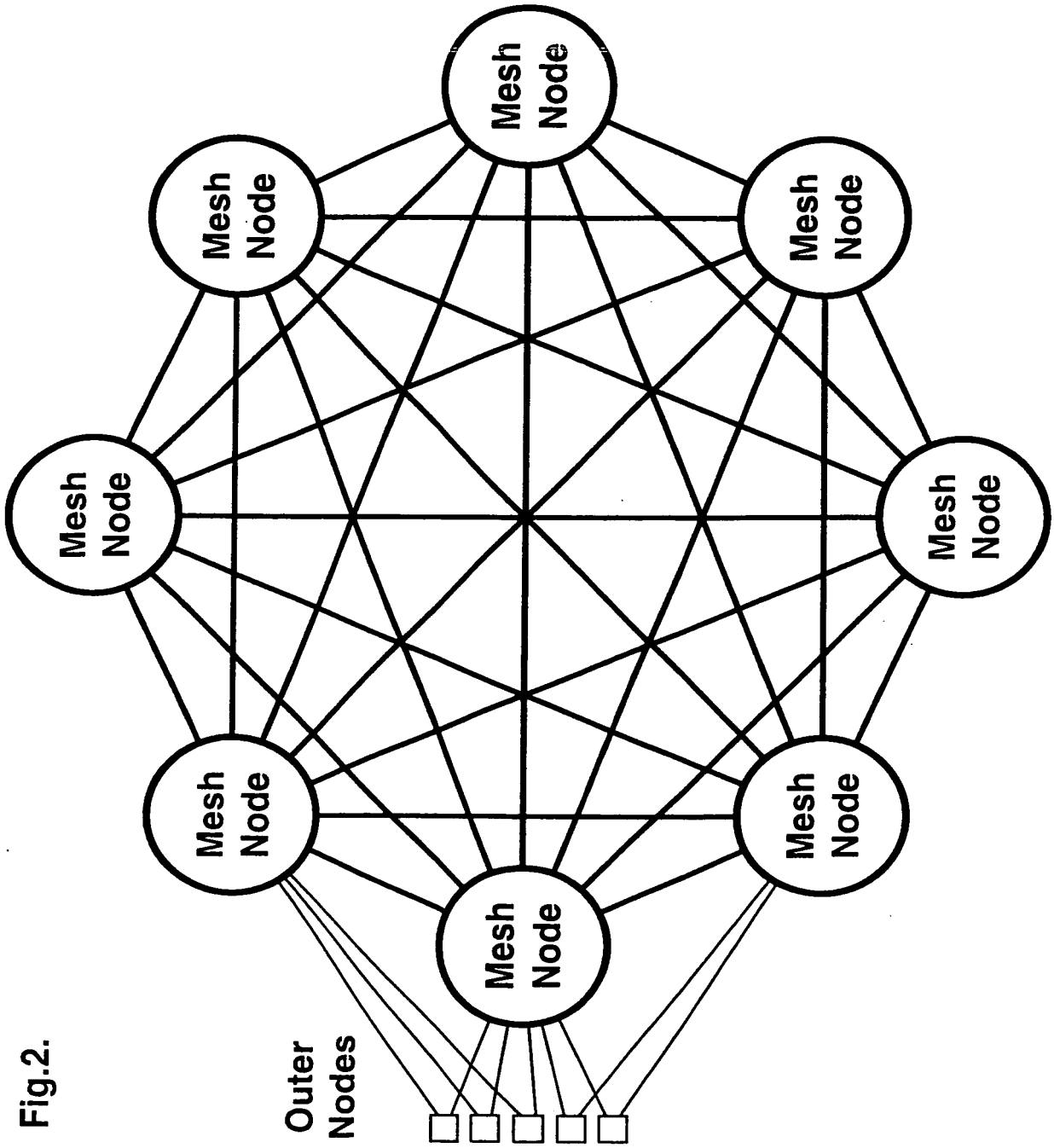

Mesh Node
Mesh Node
Mesh Node
Mesh Node
Mesh Node
Mesh Node
Mesh Node
Outer Nodes

Fig.2.

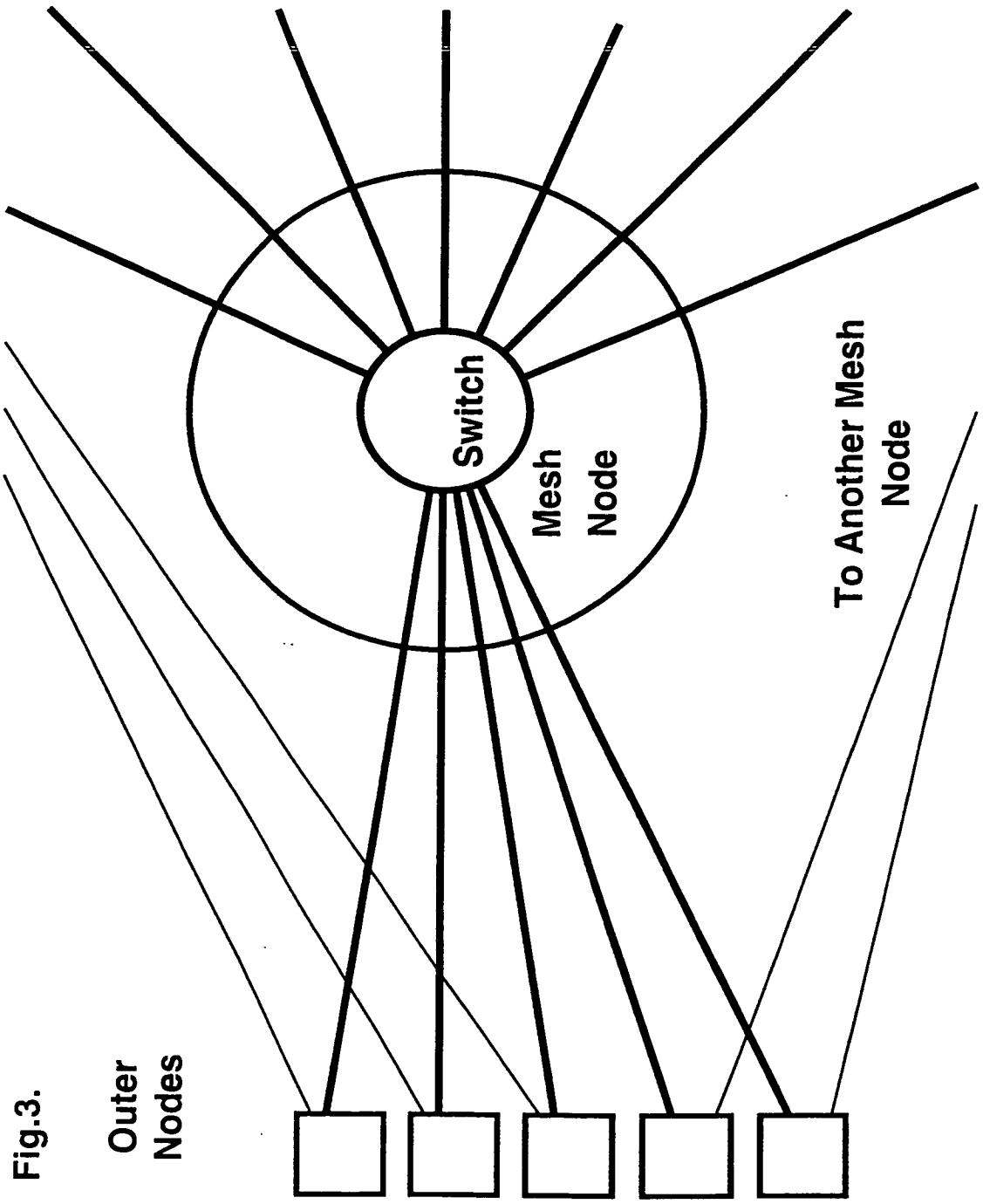

To Another Mesh Node
Switch
Mesh
Node
To Another Mesh
Node
Outer
Nodes

Fig.3.

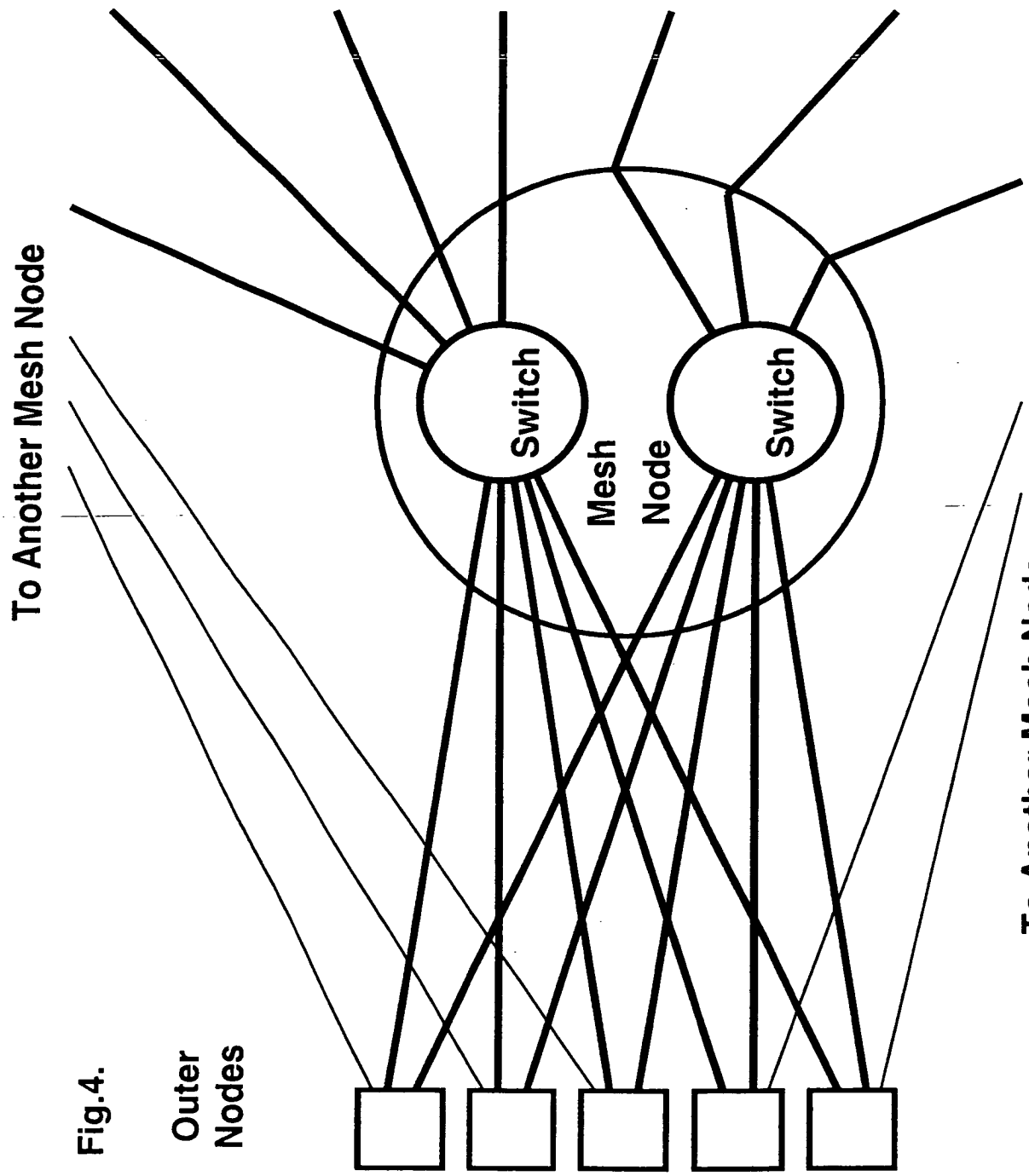
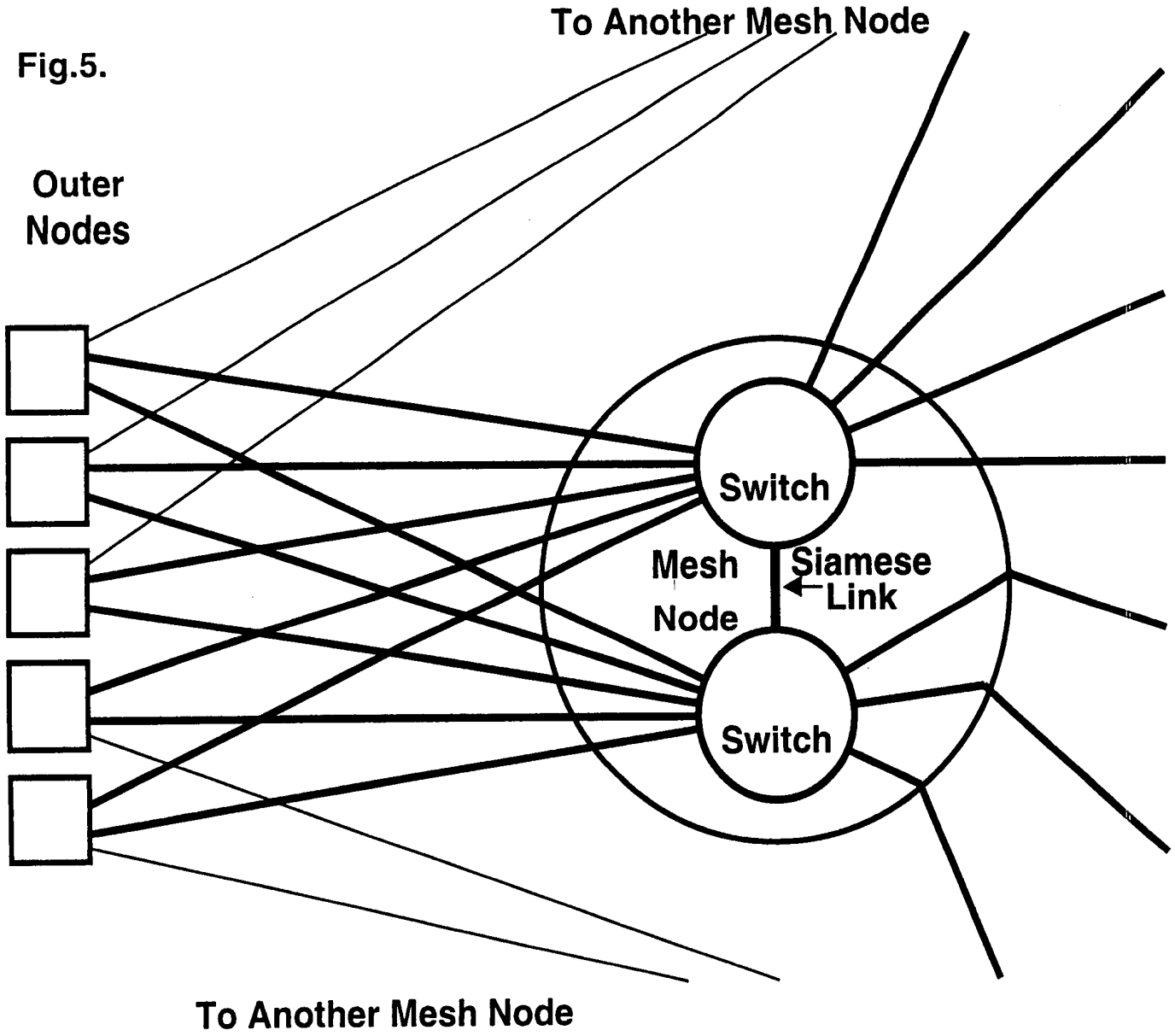

To Another Mesh Node
Switch
Switch
Mesh
Node
To Another Mesh Node
Outer
Nodes

Fig.4.

Fig.5.


To Another Mesh Node
Outer Nodes
Switch
Mesh Node
Siamese Link
Switch
To Another Mesh Node

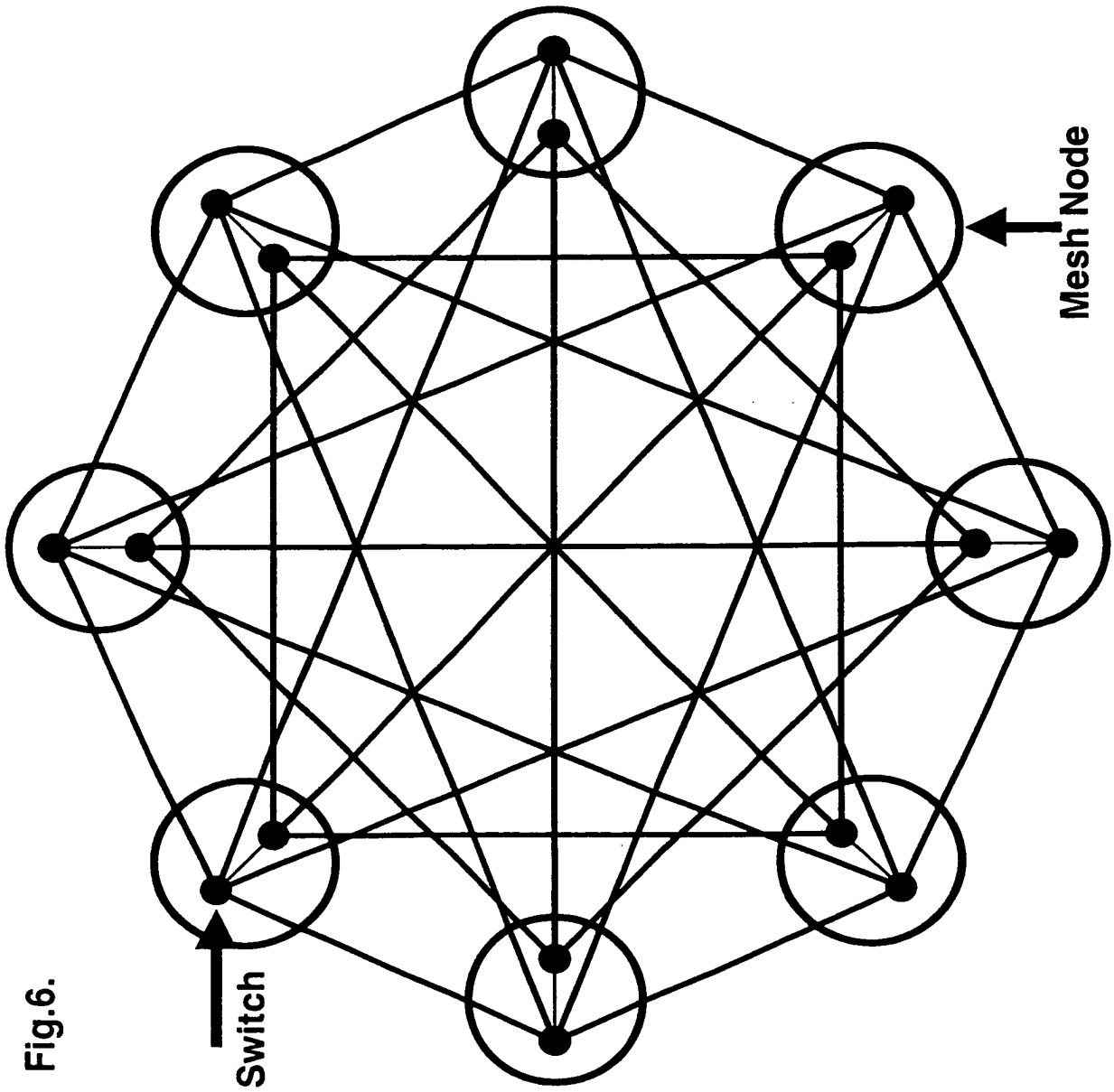


Fig.6.